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ABSTRACT

This investigation is part of an ongoing, larger study which is looking at joint activity and appropriation of new understandings in an inquiry mathematics classroom setting. Instances of help-seeking which occurred while children were endeavoring to solve non-routine problems at home were analyzed. Considered in this study were (1) the kind of help sought by the child, (2) the kind of help offered by the adult, (3) how extensive the help was, and (4) the sense the child made of the help. The data sources included the children's writing in their math logs, and their explanatory presentations subsequently given to peers in class. Findings suggest that (1) the children sought and received help predominantly with respect to problem-solving strategies and mathematical concepts, (2) interactions with adults were evenly distributed among all the students-the adept, moderately adept, and less adept-in that some did ask for help while others rarely or never did, and (3) the less adept children were less specific in describing the kind of help sought/received while the more adept children's' requests were more specific and focused. (Author)

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HELP-SEEKING WHILE PROBLEM SOLVING: ADULT CARE-GIVERS AND THE ZONE OF PROXIMAL DEVELOPMENT

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This investigation is part of an on-going, larger study which is looking at joint activity and appropriation of new understandings in an inquiry math classroom setting. Instances of help-seeking which occurred while children were endeavoring to solve non-routine problems at home were analyzed. Considered in this study were (1) the kind of help sought by the child, (2) the kind of help offered by the adult, (3) how extensive the help was, and (4) the sense the child made of the help. The data sources included the children's writing in their math logs, and their explanatory presentations subsequently given to peers in class. Findings suggest that (1) the children sought and received help predominantly with respect to problem-solving strategies and mathematical concepts, (2) interactions with adults were evenly distributed among all the students, the adept, moderately adept, and less adept in that some did ask for help while others rarely or never did, and (3) the less adept children were less specific in describing the kind of help sought/received while the more adept children's' requests were more specific and focused.

The overall goal of the on-going study of which this report is a part, is to investigate "how much students appropriate from interactions with others so that they can claim this knowledge as personally meaningful" (Roth, 1995, p. xv). The specific focus of the present investigation is on the child-adult interaction in the context of help-seeking behavior. This is in accordance with Bussi's (1994) recent assertion regarding the need to give attention to the role of the adult vis-a-vis joint activity in problem solving. At the same time, Webb (1989) has pointed out the lack of research on help-seeking. Nelson-Le Gall and her colleagues (Nelson-Le Gall, Gumerman, & Scott-Jones, 1983) have spoken of help-seeking as a problem-solving skill. They suggest that it is vital to look at who seeks help, what type of help is sought, and at what point in the problem-solving process help is sought, and insist that these are all central questions for theories of problem solving (p. 280). Some researchers have concluded that help-seeking denotes dependence, while others have felt that it is a sign of initiative-taking (Nelson-Le Gall et al., 1983). Help-seeking may well be tied up with metacognitive awareness. Do the children know that they do not know? and Do they know what it is they need to know? (Fitzgerald, 1983). Thus for this component of the study, I considered specifically the help-seeking which occurred while the children were solving non-routine mathematics problems at home, and when help was sought, looked at the ensuing written explanations done at home and the oral explanations given by the children in class.

The theoretical framework of the study draws upon Vygotsky's view of the interaction which leads to learning. He maintains that it occurs on two planes, first

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the social and then the psychological plane; "first it appears between people as an interpsychological category, and then within the child as an intrapsychological category" (Vygotsky, 1981, p. 163). One vital component derived from this basic tenet is that of the *zone of proximal development* . As a theoretical construct the zone of proximal development (ZPD) has been used in a variety of ways to date. Most commonly it has been operationalized in conjunction with an apprenticeship model (see for example, Lave, 1977, Rogoff, 1990, or Cazden, 1981) in which the adult expert is guiding in a step-by-step way, and relinquishing control by degrees when the learner is 'ready'. In contrast to this view, a number of researchers support the premise that any help which leads to conceptual change in the ZPD can be considered to have assisted growth (Tharp & Gallimore, 1988). In the context of this study, and keeping with this latter view, I regard the zone of proximal development as a conceptual space in which new understandings can arise as a result of joint activity.

The school and classroom site of this study is a community of practice of *inquiry math (*Richards, 1991), in which the children are expected to publicly express their thinking and engage in mathematical practice characterized by conjecture, argument and justification (Cobb, Wood, & Yackel, 1993, p. 98). Therefore any analysis of what occurs in the joint activity in this classroom differs in essential ways from much of what has been featured in the literature. Admittedly, the children's work in joint activity with adults and peers may perhaps incorporate some features of the apprenticeship model. However, the activity in a problem-solving environment is more diffuse and in some ways more complex than that in a teacher-centered textbook-based classroom setting. For example, the primary focus is not on the learning of procedural patterns, as was the case in regard to the long-division algorithm which was the focus of learning in the 'construction zone' in the Newman, Griffin & Cole (1989) classroom study. In our setting, the children are encouraged to grapple with non-routine problems, and are seen to deliberate and solve the problems using diverse idiosyncratic approaches (Zack, in press). In our community, there are many potential sources available to the child—peers in class or at home via telephone, the teacher in class, and the caregiver at home. These multiple sources not only enrich the child's environment but also increase its complexity by posing additional challenges as children attempt to understand alternate approaches (Zack, 1993).

Data collection and data analysis

I have been a classroom teacher and researcher in a Grade 5 (10-11 year-olds) classroom for the past 6 years. Problem solving is at the core of the mathematics curriculum. In addition to the in-class problem-solving sessions, the children also work on one challenging mathematics problem at home each week (Problem of the Week), and are expected to write in detail in their math log about what they did as they worked on the problem. The children are told they must work hard alone on the problem at first. They are asked not to seek help, and the parents are asked to refrain from assisting. However, if the children decide they must seek help, they are asked to write about their difficulties, about whom they approached for help,

and about how the person helped them. Subsequently in class, each child discusses her/his solution with a partner, and then in a foursome; the problem solutions are then discussed in a group of twelve. The in-school problem-solving sessions are videotaped.

The data analyzed for this paper were drawn from two years worth of Problems of the Week, 1993-1994, and 1994-1995; 8 problems which had been assigned in both years were chosen for the analysis. The class size each year was 25 and 26 children respectively. Considered in this study were (1) the kind of help sought by the child or (2) offered by the adult, (3) how extensive the help was, and (4) the sense the child made of the help (intrapsychological), as seen in the writing in the math logs, and the explanatory presentations subsequently given to peers in class. I looked for instances of the following: (a) the child had a correct answer and had sought help; (b) the child had a correct answer and had not sought help; (c) the child had an incorrect answer and had sought help; (d) the child had an incorrect answer and had not sought help. In the cases where the child had a correct answer and had sought help, and that child subsequently shared her/his steps with a partner or small group, I looked at the videotape and at my focused observation notes to see whether that child was able to explain, and to justify her/his actions. The students know they are expected to go beyond just sharing their answer with each other; each child is expected to tell how she/he arrived at the answer, and to attempt to explain why it works.

I also looked to see at what point in the problem-solving process the child sought help at home. Polya's (1945) stages of clarifying, representing, solving, and checking were considered; instances of help-seeking from adults were almost exclusively related to stages of representing and solving. In order to analyze further the kinds of help the children reported they had been given by the adults, I used categories which had emerged from a previous study which dealt with children's reports of the kinds of help peers gave in class (Zack, 1994). The categories were as follows:

Category #1: parameters or conditions of the problem

Category #2: factual, straightforward information

Category #3: problem-solving strategies (included as well diagnosing errors, getting started)

Category #4: mathematical concept (e.g.. fractions, decimals, percents)

Category #5: essence or key idea in a problem

Category #6: alternate solution (i. e. one which is simpler or aesthetically more pleasing).

Findings

Findings suggest that interactions with adults were evenly distributed among all the students, the adept, moderately adept, and less adept; some did ask for help, while others rarely or never did. Overall, the frequency with which children did go to caregivers at home for help was low. This may be due in part to the teacher's request that they do their best to work on the problem diligently on their own; it may be due to the fact that some children feel (as they had reported in reference to

another component of the study) that they gain more from working with peers in the classroom than from working with adults, since children of the same age "speak the same language"; it may in part be due to the shying away from challenging problems on the part of some of the caregivers. One finding which emerged was related to cases in which extensive input had been given to less adept children by an adult (parent, babysitter, or tutor). In the 6 cases (out of 13 instances) which I had the opportunity to observe, the children were able to present the solution but they could not adequately defend or explain the specific components of the solution strategy to their peers.

The results indicate that when interacting with adults, the children sought and received help predominantly with respect to problem-solving strategies (Category #3) and mathematical concepts (Category #4). Interestingly, within the child-child interaction the incidence of occurrence of explanations related to mathematical concepts had been very low (Zack, 1994). Other findings suggest that the less adept children are less specific in describing the kind of help sought or received while the more adept children are more specific and focused in their requests and descriptions. In addition, there were two striking instances in which adept children were seen to do much with only minimal input from a parent.

A number of children who did not find the explanations of the caregiver helpful continued to seek to make meaning, and at times were seen to connect the help given by peers in class to the attempts made by the caregiver. In one instance a child did understand his older brother's explanation; however, the child sought and developed another approach (giving me, the teacher, credit for a hint) which he felt would be more accessible and meaningful to his peers when he presented his solution in class the next day. His writing in his math log signaled to me his willingness to pursue alternative ways of solving and presenting, as well as his awareness of the various registers of mathematical discourse, some more 'user-friendly' and more likely to be understood by peers than others. Of interest as well was the finding that the children appeared selective about whom they approached for help at home, and at times spontaneously volunteered the reasons why one candidate was preferred over another.

One aspect worthy of future study is that of the relationship of the gender of the caregiver to the kind of help that is given. Confrey (1995) noted recently that in studies of mother-child versus father-child interactions, researchers have reported that mothers tend to decenter toward the child's activities and goals, while fathers tend to coax the child to accomplish their (the fathers') goals. Due to the small number of instances, no conclusions could be drawn from occurrences in this study; however, it seemed from the few instances that the mode of working in regard to non-routine problem-solving situations might be less related to gender than to the adult's own level of development vis-a-vis mathematics.

This report constitutes a preliminary investigation of how children and caregivers might learn about mathematics through joint activity. The face-to-face interaction between parents (and other caregivers) and children is an important area of investigation which needs to be examined more broadly and in greater detail. The results of such an investigation would contribute both to our general

understanding of the social construction of knowledge, and to our more specific understanding of the workings of the zone of proximal development.

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